AD-A193 686 LASER STUDIES OF GAS PHASE RADICAL REACTIONS(U) OXFORD UNIV (ENGLAND) PHYSICAL CHEMISTRY LAB G HANCOCK 31 MAR 88 DAJA45-85-C-0034 1/1

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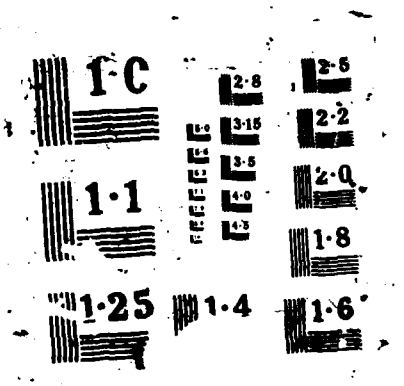
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Laser Studies of Gas Phase Radical Reactions

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Contract Number : DAJA 45-85-C-0034

6th Periodic Report
1 October, 1987 - 31 March, 1988

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1) CF Chemistry

Radiative lifetimes of the $CF(A^2\Sigma^+)$ v=0 and v=1 levels have been measured, with values of 26.7 and 26.1ns obtained respectively. This is the first time that such direct measurements have been reported, and the work is now being prepared for submission to Chemical Physics Letters.

2) O + CF and O + CF_2 reactions

Interferograms of IR emission accompanying the O + CF_2 reaction have been recorded as a function of time, and thus the complete two dimensional (time and wavelength) mapping of the products of the reaction have emerged. Figure 1 shows a time history of the complete IR emission (all wavelengths) following the photolysis of CF_2HCl (to produce CF_2 radicals) in a flow of atomic oxygen. Figure 2 shows how the emission between 1700-2500 cm^{-1} evolves with time, and from this we learn of the vibrational distribution of the nascent products (vibrationally excited CO, which relaxes by collisions), and can unravel secondary mechanisms (at 2300 cm^{-1} there is evidence of CO_2 being formed, we believe from the O + FCO reaction, FCO being a product of O + CF_2). Figure 3 illustrates another emitting species, HF, formed from the reaction between F atoms (produced by O + CF_2) and HCl (produced as a co-product of CF_2 in the photolysis of CF_2HCl) and shows the resolution capabilities of the equipment.

Clearly much more work is needed to understand the emission fully, and we have identified the major problem in carrying out this work efficiently. Our present photolysis laser operation at only 1Hz. We have thus recently applied to the SERC for funds to purchase a 20Hz system, and if successful, this should enable a large number of results to be obtained by the end of the current US Army grant period.

3. H_2O photolysis

The work carried out during Professor Halpern's visit on the polarisation of emission from OH and OD produced in the two photon dissociation of H_2O and D_2O is still in the process of being written up for publication. A publication entitled 'Photoaffinity Labelling of Isopenicillin N Synthetase' by J.E. Baldwin, J.B. Coates, J.B. Halpern, M.G. Maloney and A.J. Pratt has been submitted to Biochem. Biophys. Acta, and describes further work carried out by Professor Halpern and mentioned in the last report.

4) O + CS reaction

The O and CS sources have been tested, both O and CS have been detected by 2 and 1 photon LIF respectively. CO rotational state distributions have been measured in the v=13, 14 and 15 levels : for v=14 these have been carried out at pressures down to 3×10^{-4} Torr. We are still unsure as to whether these are true nascent distributions, and are continuing to investigate the problem.

5. Visit to BWL

During the last reporting period, a visit was made by Dr. G. Hancock to BWL at Aberdeen, and was inadvertently not mentioned in the 5th periodic report. Contact was made with Dr. George Adams, the Scientific Liason Officer for the project, and with Dr. Andrezi Miziolek, whose research is very similar to that carried out under this contract. Several areas of mutual interest were identified and discussed.

6) OCAK

The Principal Investigator and two colleagues in the Physical Chemistry Laboratory at Oxford, have set up a new research group, known as the Oxford Centre for Applied Kinetics. The aim of the group is to study the fundamental photochemical and kinetic behaviour of systems of interest in applied chemistry (in areas such as combustion, aeronomy and plasma chemistry), and it is hoped that eventually the laboratory will be completely self supporting from outside contracts. We have already attracted considerable financial support from the University and Governmental funds, which has enabled us to purchase the necessary starting equipment (including three new laser systems). We would hope that our capabilities and expertise would be of interest to the US Army and would be very keen to submit an application after the completion of the present funding contract.

The research plans for the remainder of the contract are substantially as in the proposal and in the development of it as given in the periodic reports.

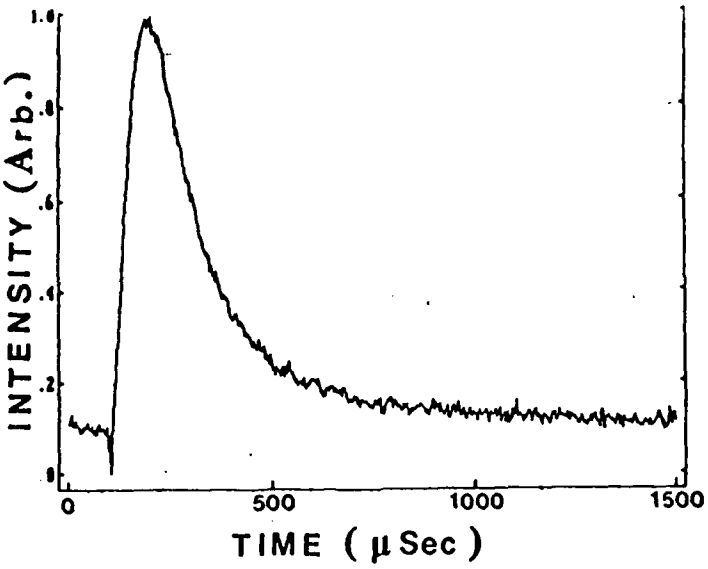

Figure 1

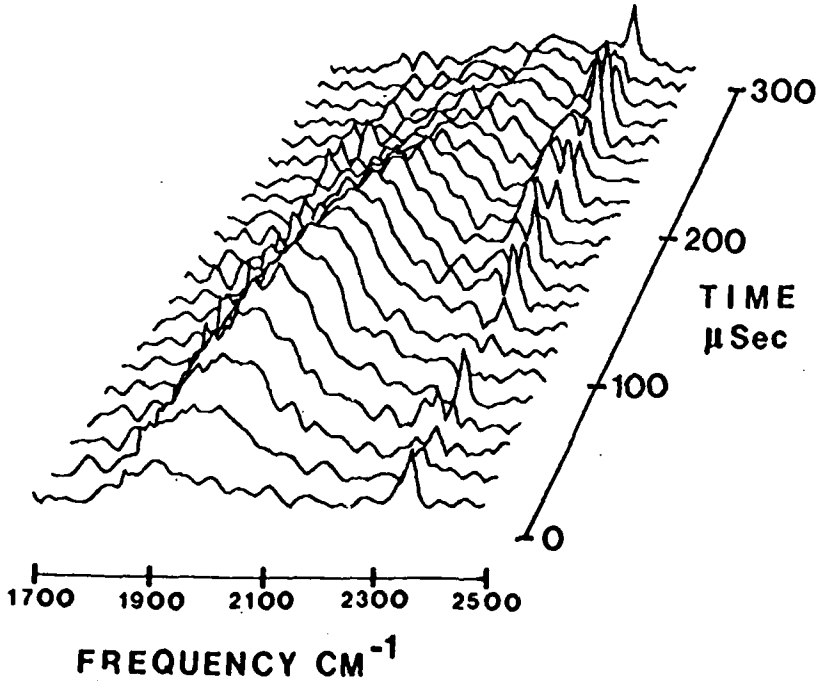

Figure 2

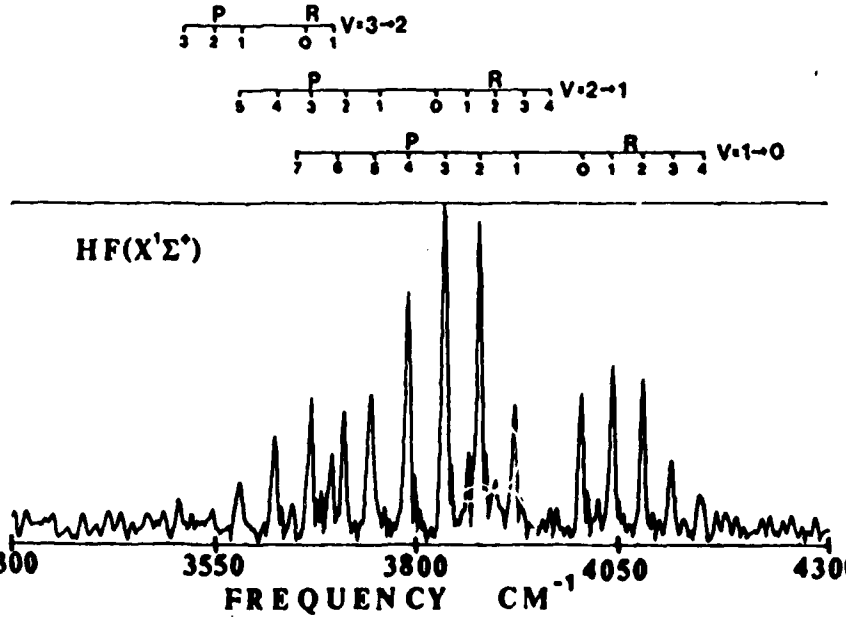

Figure 3


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